

学校编码: 10384

分类号_____密级_____

学号: B200242005

UDC _____

学 位 论 文

资产收益的跳跃行为及其对波动性影响的实证研究

An Empirical Study on Jump Behavior of Asset Return and Its Impact on Volatility

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专 业 名 称: 金 融 学

论文提交日期: 2005 年 3 月

论文答辩时间: 2005 年 6 月

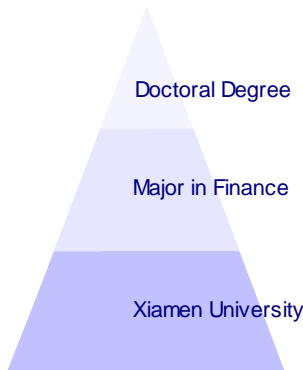
学位授予单位: 厦 门 大 学

学位授予日期: 2005 年

答辩委员会主席: _____

评 阅 人: _____

2005 年 6 月



金融学博士学位论文

Ph. D. Dissertation of Finance

资产收益跳跃行为的理论与实证研究

A Theoretic and Empirical Study on Jumps in Asset
Return Processes

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April 10, 2005

声 明

本人声明：本论文是我申请厦门大学经济学院金融学专业博士学位材料的组成部分。根据厦门大学研究生院颁布的相关规定与通知条例，本人在论文的撰写过程中，严格遵守了学术研究的道德规范与标准。作者感谢导师陈浪南教授以及答辩委员会委员的指导和帮助，文中的错漏概由本人负责。



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Statement

I state that this dissertation is a part of work of my application for doctoral degree of finance in financial economics. Following the guidelines of related regulations stipulated by Graduate School of Xiamen Uinversity, I complied with the academic morality, regulations and standards during working on my dissertation. Special acknowledgements are given to my supervisor, Professor Lannan Chen, and oher members of dissertation defense committee while any error in this dissertation remains my own responsibility.



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内容摘要^{*}

资产收益通常进行连续低幅度的漂流变化,这可归因于投资者例常的流动性交易与策略性交易。但是,当市场出现重大或者异常信息时,例如制度变迁、政策调整的公布(宏观经济层面)或者公司赢利、投资项目的披露(微观经济层面),资产收益将很可能产生突发性的、大规模变化,即跳跃行为。

跳跃行为不仅迅速地对资产的即期收益造成冲击,而且会进一步影响到波动性与风险溢价等各个方面,因此深入地分析资产收益过程中的跳跃行为显得尤为重要。

本文对跳跃行为的研究主要考察五个方面的问题:一是跳跃行为对波动性的影响;二是波动性对跳跃行为的反馈效应;三是波动性非对称效应中的位移效应;四是跳跃行为发生概率的动态规律;五是中國资本市场收益跳跃行为的特征分析。

本文对跳跃行为的研究由两个步骤完成:第一,建立理论模型;第二,进行实证分析。在建立模型时,本文提出了 **EARIV-GARCH** 模型。在该模型中,资产收益通常的漂流变化由非对称 **GARCH(1,1)**波动性过程驱动,跳跃行为则由离散的 **Poisson** 随机过程产生。怎样恰当地设计出一个控制 **Poisson** 过程事件发生概率的跳跃强度是一个至关重要的问题,本文设计的跳跃强度具有这样的特征:首先,考虑了事后推断出的跳跃行为对跳跃强度的影响。跳跃行为的发生会对跳跃强度造成何种影响?对该问题我们可能存在两种相互矛盾的观点,由此本文提出了两个不同的假说。一是“市场压力减弱”假说,即认为跳跃行为的发生释放了压力,市场必须重新积

^{*}本文为国家自然科学基金项目 (70473106)的最终成果之一

累力量以便再次发生跳跃行为，因此跳跃强度应该会降低。二是“市场能量释放”假说，即跳跃行为的发生预示交易将会变得更为活跃，因此跳跃强度应该增强。本文设计的跳跃强度能够同时兼容这两种假说。其次，跳跃强度受 GARCH 波动性的影响，使得后者能够从一个更为有效的渠道对跳跃强度产生反馈效应。最后，跳跃强度可以存在低阶的自回归性质。在建立模型时，本文引入了一个附加的波动性非对称效应来源，即位移效应，用以反映投资者对某类资产可能持有的一种非零的收益预期或者损失容忍。对于模型的估计，本文提出了随机 PDF 算法。该算法能够在一定程度上避免局部最优的问题。

在第二个步骤中，本文同时采用沪深 A 股 B 股指数以及 9 家单股对模型以及相关的假说进行实证分析。实证结果表明，A 股与 B 股指数均显著地存在跳跃行为。指数支持市场压力减弱假说，但在波动性的非对称效应中没有发现显著的位移效应。单股则分别支持这两种不同的假说，并且发现了位移效应，而且是一致地为负数，即投资者对这些股份持有非零的损失容忍。此外，无论是单股或者指数，都表明跳跃行为是迅速地反应在资产即期价格上，而一般不会大幅度地增强 GARCH 波动性，从而持续地对收益造成长期的效应。但是跳跃行为的发生的确会改变跳跃强度现有的状态，从而对资产收益造成更为潜在的影响。另外，该部分内容概括了沪深两地指数收益的变化特征，并对 EARIV-GARCH 的残差、样本外波动性的预测能力进行了实证检验。实证结果表明，EARIV-GARCH 模型优于现有的模型。

本文提出了一个全新的跳跃强度状态方程，完善了波动性的非对称效应的设定，设计了一个新的随机算法，首次分析了中国资本市场收益跳跃行为的特征。

本文的研究建立了一个更合理的标的资产收益过程模型，从而为期权、期货等衍生品的定价奠定一个坚实的基础；同时对收益总体波动性进行了分解，因此为 VaR 的估计提供了一种新的思路。

本文的研究结果有助于深刻理解资产价格的形成机制以及中国资本市场的发展历程。

关键词：跳跃行为；波动性；跳跃风险



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Abstract

Asset returns usually follow a continuous and small-scope change due to investors' routine liquidity trading or strategy trading. Whereas, when the arrival of important or abnormal news, such as systematic reform and policy change announcements (at the macroeconomic level) or earnings and investment project reports (at the firm's level), asset returns are most likely to be induced a sudden and great movement, which is also called a jump.

Not only the jump will affect spot return quickly, but also may cause further impact on volatility and risk premium. Therefore, it is important to investigate jumps in asset return processes more clearly. This study on jump focuses on the following issues mainly: the effect of jump on volatility, the feedback effect of volatility on jump, the shift effect within asymmetries in volatility, the dynamics of jump intensity; and the characteristics of jumps on asset returns in China's stock markets.

This study on jump is accomplished through two steps. Step 1, this study constructs a new model, called EARIV-GARCH. In this model, the normal asset return diffusion is driven by asymmetric GARCH(1,1) process, while the jump is engendered by discontinuous Poisson stochastic process. How to design a right jump intensity dynamics, which controls the occurrence probability of jump, is crucial to this study. The jump intensity designed by this study has the following characteristics. First, it is assumed to be affected by the jump inferred using ex post information. Which kind of influence will the occurrence of jump make on jump intensity? We may have two contrary

viewpoints, so two different hypotheses are proposed by the author. One is “Market Stress Reduction Hypothesis”, which assumes that the jump intensity will decrease when a jump occurs, since the occurrence of jump releases the market stress, and the market must restart to accumulate strength so that it can make a second jump. The other is “Market Energy Release Hypothesis”, which means the jump intensity will increase after the arrival of jump, since the occurrence of jump indicates that trading will become more active, thus jumps are more likely to occur. The dynamics of jump intensity designed by this study takes into account both hypotheses. Second, intensity is volatility dependent. Volatility can affect jump intensity directly. Jump intensity is also assumed to be autoregressive within low lags. While constructing the asymmetric GARCH (1,1), this study introduces an additional asymmetric effect source in volatility, that is shift effect, which reflects a nonzero return expectation or endurable loss hold by investors. After this modification, the model can describe the asymmetric effect in volatility powerfully. Finally, a new stochastic algorithm is also constructed to estimate the model, which can avoid local optimization effectively.

Step 2, the model and related hypotheses are tested by employing returns of Share A and Share B indices and individual stocks from Shanghai Stock Exchange and Shenzhen Stock Exchange. Empirical results indicate that there is compelling evidence of the existence of jumps in both indices and individual stocks. The indices support the Market Stress Reduce Hypothesis and haven't been found out significant shift effect. But the individual stocks support the both hypotheses respectively. Shift effects are found significantly in some

stocks. It indicates that investor bears nonzero enduring loss on these companies' equities. On the other hand, both individual stocks and indices suggest that jump is incorporated quickly in current returns, and usually will not magnify volatility of GARCH component greatly then have obvious long-term effect on asset return. But, the occurrence of jump surely will affect jump intensity dynamics, which may have latent influence on return process. At the end of this step, the author also summarizes the characteristics of indices in China's stock markets, and conducts distribution test for standard innovations. The ability of the out-of-sample volatility forecasting of the different models are also evaluated and compared. The empirical results show that EARIV-GARCH outperforms other models, such as TGARCH or GARIJ model.

This study introduces a new jump intensity dynamics, improves the definition of asymmetries in volatility, designs a stochastic algorithm, and analyzes the jumps in returns from China's stock markets.

This study establishes a firm foundation for option and future pricing, and also provides a new way to estimate the VaR.

The results of this study will be helpful for understanding the asset pricing mechanism and the development in China's capital market.

Key words: jump; volatility; jump risk



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